

## THE POWER SYSTEM VOLTAGE STABILITY ANALYSIS CONSIDERING WIND POWER GENERATION

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### ABSTRACT

*Wind control industry is growing extremely expansive so increasingly more wind ranches are assembled and its being associated into the power framework. The wide size of wind control age is likewise increment so sway on substantial scale wind control age is additionally impact into the power framework. By coordinating vast scale wind factories into the power organize, framework faces a few issues. Those issues are activity and control, music and power stream, voltage solidness, soundness of framework, nature of intensity. So these issues because of wind unevenness age are principle look into core interest. Diverse sorts of wind control generators/turbines impacts affect these issues, so this paper comprise such issues and its alleviating strategies.*

**Index Terms:** Wind Power Generation, Voltage Stability, Harmonics & Power Flow

**KEYWORDS:** Geographical Indications, GI Registration, Marketing Management, Product Differentiation & Intellectual Property Rights

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### INTRODUCTION

In the past 30 years, the measure of wind plants has been extended step by step on a very basic level. So government tenets of government were so natural to grow new wind plant. For instance, in earlier years, wind turbines were simply needed capacitor (responsive part) pay at each turbine to control the no-heap receptive power age. However at this point step by step the breeze control age is expanding quickly so dependability and power quality issues are happen in the interconnected framework. A breeze control plant or wind ranch is associated with the power matrix in ordinary condition, so it is most critical for us to think pretty much all wellsprings of unsettling influence which is hazardous for system and affect the framework in voltage and recurrence as less as conceivable variety ought to be there, so those are working in stable condition. Music additionally causes mutilations in current and voltage, along these lines it should control. This paper contain the serious issues which are related to extensive scale wind control system organize to the fundamental power matrix. In this report different chart of electrical amount of different transport under blame condition and under typical condition are appeared. So from P-V Curve and voltage chart, we can examination of voltage strength. So this paper presents about specific issues investigation and its recreation of voltage.

## WHY WIND ENERGY

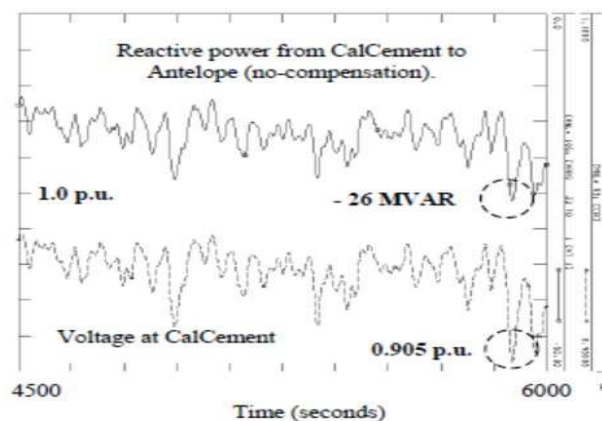
Power request is constantly expanding with expanding development of populace with step by step. So just ordinary power plants like atomic power plant, warm power plant and so forth these plants are not ready to fulfil all heap request. These regular power plants produce hurtful gases likewise and its influence on condition and human life moreover. So to satisfy all heap request and for less contamination non customary power plants like hydro vitality, sun based energy, wind energy etc. are the present necessities. For substantial scale control arrange hydro and wind control plant are generally appropriate. For the most part hydro control is increasingly costly as contrast with wing power plant. Furthermore, wind vitality is for the most part accessible all through the entire day and year. In any case, if there should be an occurrence of hydro control plant, hydro control is relies upon the wellspring of water accessibility. Wind mile can worked in wherever however by and large its area ought to be there where more wind is accessible like groundand close seashore and so on some power source quality issues can undoubtedly settled in wind control reconciliation into the fundamental power network effectively.

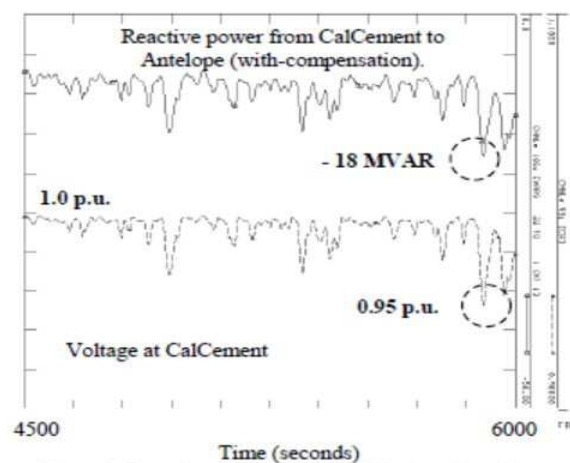
So wind control is today's most appropriate and prerequisite.

## POWER QUALITY ASPECTS IN WINDMILLS

### Voltage Variation

Voltage variety is done due to change in windmills speed and furthermore correlation among uncompensated and remunerated framework. In any system to improve the properties of voltage of wind plants on the off chance that responsive power play is used, at that point it is called repaid organize. A fixed capacitor bank, static compensator and exchanged capacitor bank is helpful for responsive power source compensator however SVC is least complex strategy. In the wake of discovering genuine estimation of the capacitor and inductor, Static voltage remunerated work to create responsive power source and scope of that control differs receptive power  $Q$  to + responsive power (+ $Q$ ).





**Figure 2: Q from Bus, and V at Bus with Reactive Power Compensation**

### Frequency Variation

Rate of progress of real power stream impact the recurrence variety or change in ROCOF. Voltage solidness or properties are improved by receptive power source in the wind factory plant and the zone close to wind factories. Receptive power source remuneration isn't affected by genuine power source flow. In any case, recurrence changes are more that it can see that demonstrated the rate of progress of genuine power (RORP) in the uncompensated and remunerated framework are different. The base recurrence happens at most extreme rate of progress of intensity stream rather than higher power flow.

### Impact of Wind Mills on Power System Quality

On the nearby dimension variety in voltage is serious issue related in wind control age. This can be restricting on measure of wind control ages introduce limit. Voltage nature of wind turbine is partitioned by:

- Steady state voltage under constant creation of intensity.
- Voltage fluctuations o Flicker amid activity
- Flicker because of exchanging

### STEADY STATE VOLTAGE

The voltage difference can be determined with burden own strategies just as other reenactment systems. At PCC voltage ought to keep up with utility points of confinement. Voltage is affected by activity of wind turbines in the associated system. Proper strategies ought to be taken to demonstrate that the wind turbine does not bring the estimation of the voltage outside the points of confinement".

### VOLTAGE FLUCTUATION

In view of light flicker wave contingent upon recurrence and greatness, the fluctuation in system voltage depends. Such a sort of unbalance/aggravation is known as voltage flicker. Very are different kinds of flicker discharge which is identified with wind turbine, the flicker emanation amid constant task of framework and flicker outflow because of turbine/generator and exchanging of the capacitor bank. Singular utilities build up admissible flicker limits. Quick changes in power result from the wind generator like the witching of generator, capacitor bank exchanging can likewise result in the

root mean square estimation of voltage. Taken after by using " flicker calculation diagram" the flicker estimation is in light of the estimations of 3-stage arrange current and voltage.

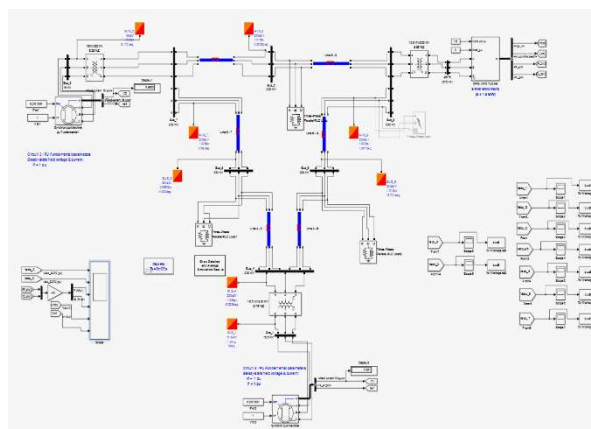
### Reactive and Active Power Flow

Burden flow computation including wind ranches is commonly connected to find the effect of windmills control age on power framework. The primary undertaking is the manner by which to manage the breeze turbines and the hub kind of the purpose of basic coupling (PCC). Wind plant is a sort of piecemeal and stochastic power source, which will muddle to coordinate to control lattice. Since numerous windmills are worked far end from burden focuses to grasp more twist vitality, there is in every case a few issues of transmitting and appropriating wind control. Some transmission lines and other electrical kinds of apparatus might be over stacked when the additional breeze source is exhibited. So it is hard to be ensured that the interconnecting transmission or scattering lines won't be over stacked. Both responsive power and dynamic power necessities ought to be determined. Responsive power is produced at Point of normal coupling, yet in addition in grid network, and ought to be repaid locally.

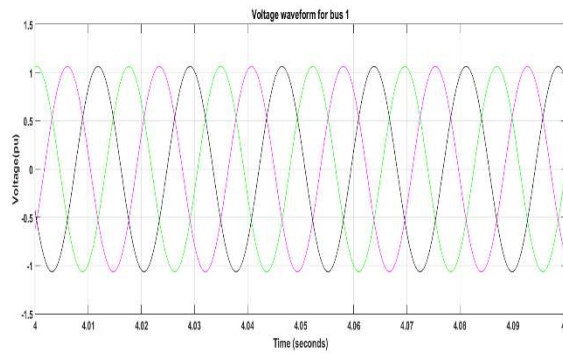
### Mitigate Windmills Power Generation Influence

The uses of the responsive power pay gear, as STATCOM and Static Var Compensator (SVC) assume a critical job at windmills control age to relieve its influence on the power framework arrange. So as to keep up the voltage level, the power framework enterprise may give extra voltage control offices. Receptive power remuneration instruments ought to be introduced in the progression up substation of windmills, which has a brisk reaction trademark and can be controlled constantly, for example, STATCOM and SVC and so on advanced and new innovations likewise advantage to the development of windmills control age in the power framework. The pitch-directed turbine can facilitate the recuperation of the breeze turbine speed after disappointments and improve the power framework soundness. It is able to deal with windmills control and of responding quickly enough to neutralize voltage varieties in a fantastic manner, which can improve the power framework solidness and power lattice quality.

### SIMULATION



**Figure 3: IEEE 9 Bus System without Fault**



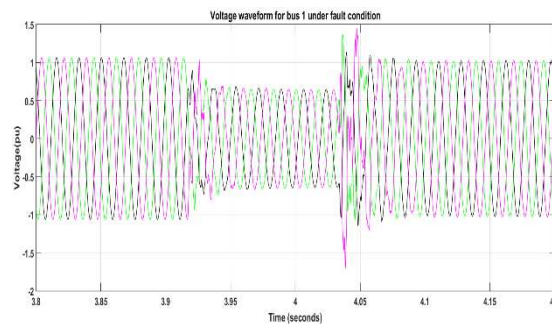
**Figure 4: Voltage Waveform for Bus 1**

Figure 3 shows the IEEE 9 bus system having one wind turbine and 2 synchronous generators. Here no fault is created so the system is running under normal condition.

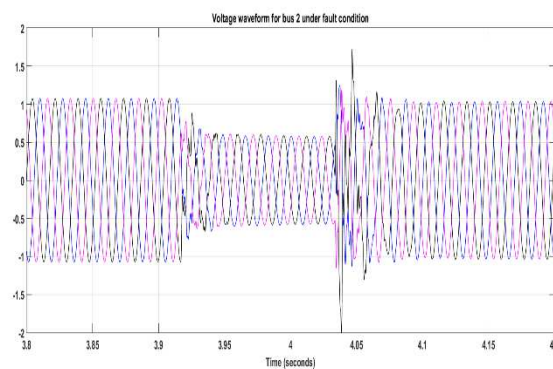
Figure 4 shows the voltage waveform for bus 1. All buses voltage are 3 phase sinusoidal. At starting system feels little fluctuation in voltage because of wind turbine, but after few cycles' system get steady state voltage at all buses. So under normal condition(no fault condition) at all bus waveforms of voltage are almost same but the magnitude of voltage may or may not be same.

Now as the 3 phase to ground fault occurred in the system waveforms of voltage current power change which is according to the type of fault.

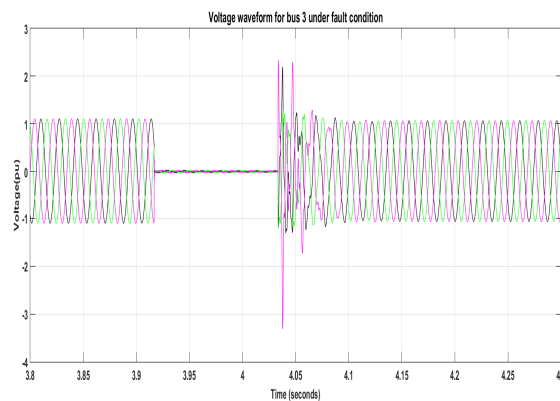
The figures given below are voltage waveform under fault condition for various buses.



**Figure 5: Voltage Waveform for Bus 1 under Fault Condition**



**Figure 6: Voltage Waveform for Bus 2 under Fault Condition**



**Figure 7: Voltage Waveform for Bus 3 under Fault Condition**

Figure 5,6 and 7 are voltage waveform for bus 1,2 and 3 respectively under fault condition.

A synchronous generator which is swing generator associated with transport 1. Here figure 5 demonstrates the voltage examination under fault condition. Here before the fault condition voltage is typical, however as the fault happens in the system, voltage diagram bothers. As the fault is explained, after a couple of cycles of unsettling influence, framework compasses to unfaltering state esteem.

For all buses which are far from the point where the fault is created the waveform of the voltage is same, even post disturbance condition and pre disturbance conditions of voltage are same only during fault voltage waveform is changed. Here due to reluctance of transmission line and load, voltage is not fully dropped so during fault condition only 37.5% voltage drop is occurring.

But for those buses where the fault occurs, resistance of the line is very low because transmission line length is very low. So reactance is near to zero value so almost 100% voltage drop occurs in the system during fault. So from voltage waveforms under fault condition and without fault condition we can analyze voltage stability.

## CONCLUSIONS

Wind control plant age is beneficial as a contrast with atomic and warm power plant. In opposite side it has disadvantages moreover. By incorporating windmill age to the primary power matrix, its effect on control organizes. So a few causes are looked into the framework. Those causes are talked about in this exploration work. However at this point issue of arrangement is accessible. By utilizing power gadgets instrument and utilizing different sorts of generators these causes can be tackled. So the negative effect on power grid can be declined by these strategies. In this exploration work voltage examination of IEEE 9 transport framework is appeared. Here in broken condition and under ordinary condition voltage waveforms and examination are connected. From the waveforms, we can distinguish that after fault is comprehended framework indicates the unsettling influence for fewer cycles. Be that as it may, after a couple of cycles/tests of unsettling influence voltage comes to consistent state esteem or typical condition. From PV bend additionally voltage security examination is conceivable.

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